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Undergraduate Research Thesis

Tail Docking in Sheep and Cortisol Levels

Abigail Hooker
Hooker.189@osu.edu
Department of Animal Sciences
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Project Advisors

Dr. Monique Pairis-Garcia
Department of Animal Sciences
222E Animal Science Building
Columbus, OH 43210

Dr. Justin Kieffer
Department of Animal Sciences
327 Plumb Hall
Columbus, OH 43210

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Abstract

Tail docking lambs between one and seven days of age is a standard industry practice used to mitigate the likelihood of developing fly strike. However, there are significant animal welfare concerns regarding pain associated with the tail docking process. This study aims to evaluate the pain response of sheep undergoing the tail docking process by assessing changes in cortisol levels between sheep provided with and without analgesic. A total of 32 lambs (15 rams and 17 ewes) were enrolled on the trial and had blood collected to assess serum cortisol concentrations over a 7 day period. Two treatments were implemented in the study: 1) Control (n=16) and 2) Drug (meloxicam administered PO at 1.0 mg/kg; n= 16). Results from this study demonstrated that lambs administered meloxicam demonstrated decreased cortisol levels at 24 and 48 hours post-tail docking ($p < 0.05$) compared to control lambs. This demonstrates that tail docking is a painful procedure that can be mitigated with use of analgesics during the 48 hours post-procedure.

Introduction

Tail docking in sheep has been a controversial practice in the global agricultural community for nearly one hundred years (Graham, 1947). Many farmers decide to tail dock sheep for health or aesthetic reasons. Others choose to leave their sheep with their natural tail length to eliminate pain associated with the tail docking procedure, or to improve profits by selling to retailers who specify for non-docked tails. Docking may occur in both the fall and spring during lambing seasons. Components of the tail docking procedure have been studied, and

current research focuses on improving the welfare of sheep by decreasing or managing pain associated with the procedure.

According to Sutherland and Tucker (2011), tail docking in sheep is common and current industry practice performed on lambs less than three weeks of age primarily to prevent fly strike. Tails are docked with a knife, scalpel, rubber rings, or with a hot iron. Most commonly, an analgesic pain reliever is not used, however some veterinarians may utilize some form of pain management (Sutherland and Tucker, 2011). Sutherland and colleagues (2011) found both behavioral and physiological evidence of pain responses during and after tail docking including active behaviors indicating restlessness, change in posture, and standing very still.

Previous studies suggest that length of tail influences the occurrence of fly strike. Studies conducted by Graham and colleagues (1947) suggested that tail length left at two inches below the vulva were associated with less cases of fly strike (Graham et al. 1947). However, this research utilized subjective measurements to assess fly strike severity; consistency of fly strike scoring varied among observers. In 1994, French, Wall, and Morgan conducted a similar study to determine the incidence of fly strike and productivity in docked versus undocked lambs. The results from this study concluded that fly strike had a greater occurrence in undocked sheep, with undocked sheep expressing a 6.3 greater chance of fly strike compared to docked sheep. Although fly strike incidence was dramatically different between docked and undocked groups, production was not influenced (French et al. 1994).

Though many have studied the effectiveness of docking at different lengths in prevention of fly strike, few studies have assessed pain associated with the procedure or approaches to mitigate pain. Pain causes an immediate impact to the body and results in a compromise in animal welfare. Molony (1993) researched the behavioral responses of lambs after receiving tail

docking by three different methods to quantify pain experienced by lambs. Pain was measured by evaluating the frequency of abnormal behaviors expressed by lambs post tail docking. The three methods utilized to dock tails included 1) surgical, 2) traditional rubber ring, and 3) modified Burdizzo rubber ring. The results showed that the traditional rubber ring method caused the most restless behaviors, the surgical method resulted in fewer restless behaviors, and the Burdizzo rubber ring method resulted in the least amount of restless behaviors, indicating that this method resulted in the least amount of pain (Molony, Kent, & Robertson 1993).

Tail docking can also result in deviations to physiological parameters of the lamb. One physiological measure often used to assess stress and pain with tail docking is cortisol. Cortisol responses to tail docking have been studied minimally. Turner and colleagues (2006) studied the differences in cortisol responses after tail docking between sexes of sheep. In order to measure cortisol levels after docking, blood plasma was collected. The study concluded that female plasma cortisol levels after docking were greater than male plasma cortisol levels after docking between 1 and 8 weeks of age (Turner et al. 2006).

Additional research has focused on finding effective ways to reduce pain during tail docking. For example, Price and Nolan (2001) studied the behavior and serum haptoglobin (a protein involved in inflammation) levels before and after tail docking in a flock of 48 lambs. Carprofen, an analgesic, was given to one test group, and the other group was given sucrose. The results showed no difference in behavioral measurements or haptoglobin levels between the group given 0.5 mg/kg of Carprofen and the control group (Price & Nolan 2001).

In addition to analgesics, the effects of a topical anesthetic during docking was studied. Lomax and colleagues (2010) found that there was a decrease in pain behaviors in the lambs when given a local anesthetic (Lidocaine and bupivacaine) compared to the control group.

(Lomax et al., 2010). This study indicates that perhaps a local anesthetic could improve the welfare of tail-docked sheep. However, it does not take into account the cost and time associated with administering the local anesthetic to each animal in a flock.

In conclusion, there are various reasons for and against tail docking sheep at different tail lengths. Additional research is needed to determine the optimum pain management practice in sheep. Behavioral actions can be observed to measure pain and stress, but biochemical processes can give an accurate quantitative measure to indicate stress, such as plasma cortisol levels. The objective of this study was to evaluate the pain response of sheep undergoing the tail docking process by assessing changes in cortisol levels between sheep provided with and without the analgesic, meloxicam.

Materials and Methods

Lambs (born at the Ohio State University Sheep Facility) were tail docked between 1 and 7 days of age following standard protocol of the OSU Sheep Facility at a tail length of two vertebrae utilizing the rubber band method. A total of 32 lambs (15 rams and 17 ewes) were enrolled on the trial and had blood collected to assess serum cortisol concentrations over a 7 day period. Two treatments were implemented in the study: 1) Control (0.9% concentration saline solution; n=16) and 2) Drug (meloxicam administered PO at 1.0 mg/kg; n= 16). This procedure was completed at the OSU Sheep Facility during autumn 2016. On day one, each lamb was caught, held for oral meloxicam or saline administration, blood was drawn from the jugular vein, and then the tail docking band was applied. Lambs were caught in a random order each day. Whole blood samples were collected for six additional days in the same manner. Whole blood samples were refrigerated within 30 minutes of collection. Blood samples were then spun in a

refrigerated centrifuge in order to separate the serum samples. Serum samples were analyzed by The Ohio State University College of Veterinary Medicine in order to measure cortisol levels. All procedures received approval by the Institutional Animal Care and Use Committee of the Ohio State University.

Samples were analyzed using SAS data analysis software. Data was normally distributed, therefore Proc Mixed was utilized with the fixed effects of treatment, age, day and treatment by day interaction and a repeated measure of day with the subject as the individual lamb. A value of $P < 0.05$ was considered significant.

Results

Cortisol levels between control and meloxicam treated lambs were not different at hour 0 ($P > 0.05$) which represents baseline data collection point prior to tail docking. At 24 and 48 hours post-tail docking, lambs that received meloxicam had lower cortisol level as compared to the lambs that received saline. Additionally, at 96 and 144 hours post-tail docking, there was a trend that demonstrated meloxicam treated lambs had lower cortisol levels ($P < 0.1$).

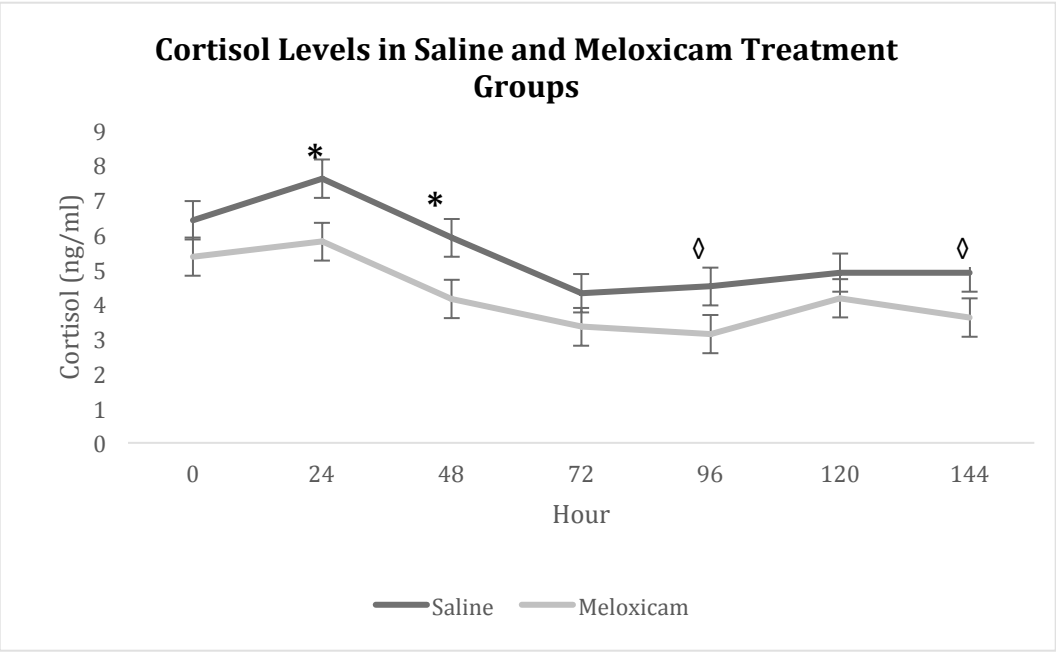

Figure 1. Cortisol concentrations least square means for lambs tail docked and administered meloxicam treatment or saline treatment

Discussion

The objective of this study was to assess the effect of meloxicam administration on cortisol concentrations in tail docked lambs. To the author's knowledge, this is the first study to assess the effects of meloxicam on cortisol levels after tail docking. Lambs treated with a weight-based dose of meloxicam prior to administering the tail docking band did not show differences in cortisol levels between lambs given in the control group prior to tail docking. Meloxicam demonstrated pain mitigation 24 and 48 hours post-tail docking as demonstrated by decreases in cortisol concentration. This suggests that meloxicam provided alleviation of pain associated with the tail docking procedure. Between hours 72 and 144, serum cortisol concentrations were not different between the two treatment groups and this suggests that meloxicam efficacy is limited 72 hours post tail docking. This could be a result of the rate of metabolism of meloxicam in sheep; past 72 hours the drug concentration would be lower than the effective dose. The results at 24 and 48 hours of this study contrast results from previous studies that assessed pain mitigation utilizing carprofen, a non-steroidal anti-inflammatory drug similar to meloxicam (Price & Nolan 2001). However, the Price and Nolan study (2001) assess drug efficacy by assessing haptoglobin levels as an indicator for inflammation, not as an indicator of pain relief. According to a study completed in 2009 by Colditz and colleagues, when studying the effects of carprofen in lambs after a non-surgical procedure, carprofen had limited efficacy when treating physiological symptoms such as elevated temperature and inflammation; however, carprofen did improve behavioral indicators of pain by two-thirds. The results from our study do coincide with

work conducted in 2010 by Lomax. Lomax (2010) evaluated the use of spray-on anesthetic for pain management during tail docking and other routine on-farm sheep procedures. Lomax measured pain through digital photography and Von-Frey hair stimulation (measurement of involuntary reflexes at wound sites). Fortunately, sheep given the anesthetic did experience less pain; however, cortisol was not measured. Spray-on and injectable anesthetics such as lidocaine and bupivacaine are less convenient than the oral meloxicam evaluated in this study.

The improvement of animal welfare, especially in a convenient and cost-effective way, is the goal of many animal caregivers. Pain management is a crucial component of veterinary procedures and should also be taken into account when considering the daily life of livestock. Currently, there is no standard industry practice to administer pain medication to lambs prior to tail docking. Judging pain levels in livestock can be subjective, but analyzing cortisol and understanding its implications of stress on the body has become a good indicator of pain assessment. This study provides evidence that welfare could be demonstrably improved for tail-docked lambs by providing oral meloxicam prior to tail docking. The implications of this study for sheep owners are crucial to the continual improvement of welfare standards. Protocols for tail docking sheep vary widely in the United States and internationally.

Oral meloxicam is more realistic for sheep owners to use on the farm than local anesthetics, yet is also shown to decrease cortisol levels. Oral meloxicam is effective for tail docking procedures like the rubber ring that seem to cause the most pain at about a day after the initial administration. Additionally, in order for the animal to experience the full effects of a local anesthetic, the professional administering the treatment must wait several minutes for it to take effect in the desired area. Additionally, spray-on anesthetics are only effective for several hours while meloxicam has a half-life of 48 hours. The use of a non-steroidal anti-inflammatory

(NSAID) drug like meloxicam can be given immediately prior to docking as it will reduce pain and inflammation as the tail becomes necrotic from the band. Additionally, oral meloxicam lasts longer (48 hour half life) in the bloodstream for longer lasting pain relief versus anesthetics that only last for several hours to alleviate pain. Meloxicam is very bioavailable orally and easily administered while the other approved livestock NSAID, flunixin meglumine must be given intravenously, requiring IV administration skills.

Further research should be conducted to explore the effects of oral meloxicam during castration given that many sheep producers will castrate and tail dock at the same time.

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